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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Marina E. Kondakova, et al

ORGANIC ELECTROLUMINESCENT DEVICES

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Examiner: Benjamin P. Sandvik

I hereby certify that this correspondence is being deposited today with the United States Postal Service as first class mail in an envelope addressed to Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Deidra L. Mack
Deidra L. Mack

October 12, 2005
Date

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Sir:

DECLARATION UNDER RULE 132

The undersigned, Marina E. Kondakova, declares that:

She has received the degree of M.Sc., Colloid and Surface Chemistry from St. Petersburg University, St.Petersburg, Russia in 1987 and Ph.D., Physical Chemistry from St. Petersburg Technological University of Plant Polymers, St. Petersburg, Russia in 1993;

Since 1993 she has been employed as a research scientist with the Institute for Molecular Science, Okazaki Japan, then with the Research Institute of the Pulp and Paper Industry, St. Petersburg, Russia, and, since 2002, with the Display and Components OLED Materials R&D Group of Eastman Kodak Company;

She is an inventor in the above-captioned patent application;

She has reviewed the outstanding Office Action and any applicable cited references;

Under her direction and control, the following two exhibits were prepared in the manner indicated:

Experimental comparison between use of 1,1-bis(4-di-p-tolylaminophenyl)cyclohexane (TAPC) or 4,4',4"-tris(N-3-methylphenyl-N-phenylamino)triphenylamine (MTDATA) in an exciton-blocking layer in phosphorescent devices.

An EL device (**Device 1**) satisfying the requirements of the invention was constructed in the following manner:

1. A glass substrate, coated with an approximately 85 nm layer of indium-tin oxide (ITO) as the anode, was sequentially ultrasonicated in a commercial detergent, rinsed in deionized water, degreased in toluene vapor and exposed to oxygen plasma for about 1 minute.
2. Over the ITO was deposited a 1 nm fluorocarbon (CF_x) hole-injecting layer (HIL) by plasma-assisted deposition of CHF_3.
3. A hole-transporting layer (HTL) of N,N'-di-1-naphthyl-N,N'-diphenyl-4,4′-diaminobiphenyl (NPB) having a thickness of 37.5 nm was then evaporated from a resistively heated tantalum boat.
4. An exciton-blocking layer (EBL) of **TAPC** having a thickness of 37.5 nm was then evaporated from another resistance-heated tantalum boat.
5. A 35 nm light-emitting layer (LEL) of 4,4′-bis(carbazol-9-yl)biphenyl (CBP) as a host and fac-tris(2-phenylpyridinato-N,$C^{2'}$)iridium (III) [i.e., $Ir(ppy)_3$] as a phosphorescent emitter at a concentration of 6 wt. % was then deposited onto the exciton-blocking layer. These materials were also evaporated from tantalum boats.
6. A blocking layer (HBL) of bis(2-methyl-8-quinolinolato)(4-phenylphenolato)aluminum (III) (BAlq) having a thickness of 10 nm was then evaporated from another tantalum boat.
7. A 40 nm electron-transporting layer (ETL) of tris(8-quinolinolato) aluminum (III) (Alq) was then deposited onto the light-emitting layer. This material was also evaporated from a tantalum boat.

8. On top of the Alq layer was deposited a 220 nm cathode formed of a 10:1 volume ratio of Mg and Ag.

The above sequence completed the deposition of the EL device. The device, together with a desiccant, was then hermetically packaged in a dry glove box for protection against ambient environment.

A second EL device (**Device 2**) not satisfying the requirements of the invention was fabricated in an identical manner to Device 1 except that the hole-transporting layer was 65 nm thick; an exciton-blocking layer was 10 nm thick and consisted of **MTDATA**.

A comparative EL device (**Device 3**) not satisfying the requirements of the invention was fabricated in an identical manner to Device 1 except for using NPB in place of the exciton-blocking material. The 75 nm thick HTL consisted entirely of NPB.

The cells thus formed were tested for efficiency and color at an operating current density of 20 mA/cm^2 and the results are reported in Table 1 in the form of luminance yield and CIE (Commission Internationale de l'Eclairage) coordinates.

Table 1. Evaluation Results for EL devices.

Device	EBL or HTL materials	Efficiency (cd/A)	Voltage (V)	Power efficiency (lm/W)	CIEx	CIEy	Type
1	TAPC	31.6	12.5	7.94	0.307	0.625	Invention
2	MTDATA	11.8	13.8	2.68	0.303	0.621	Comparison
3	NPB	22.1	12.9	5.37	0.306	0.624	Comparison

As can be seen from Table 1, Device 1 incorporating TAPC in exciton-blocking layer according to the present invention demonstrated higher luminous and power efficiencies and lower drive voltages than the comparative devices with no exciton-blocking layer or with low hole mobility material in the exciton-blocking layer. Hole mobility in MTDATA is believed to be about $3x10^{-5}$

$cm^2/Vsec$ (US 6, 867,538 B2, paragraph 50), which is about 2 orders of magnitude less than the hole mobility in TAPC ($1x10^{-3}$ $cm^2/Vsec$).

In addition, both MTDATA and TAPC are high triplet energy (2.9 eV and 2.95 eV, respectively) materials; LUMO levels of both materials are high enough to prevent electrons from leaving the light-emitting layer. Hence, both materials satisfy the requirements for exciton-blocking materials. However, using TAPC- class materials in the EBL of phosphorescent OLEDs results in improved device performance.

The undersigned declares further that all statements made herein of the undersigned's own knowledge are true and all statements made on information and belief are believed to be true. These statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

M. Kondakov

Marina E. Kondakova

Date: Oct. 12, 2005